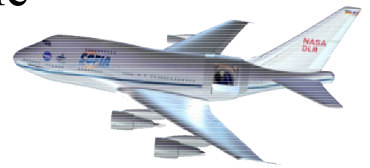




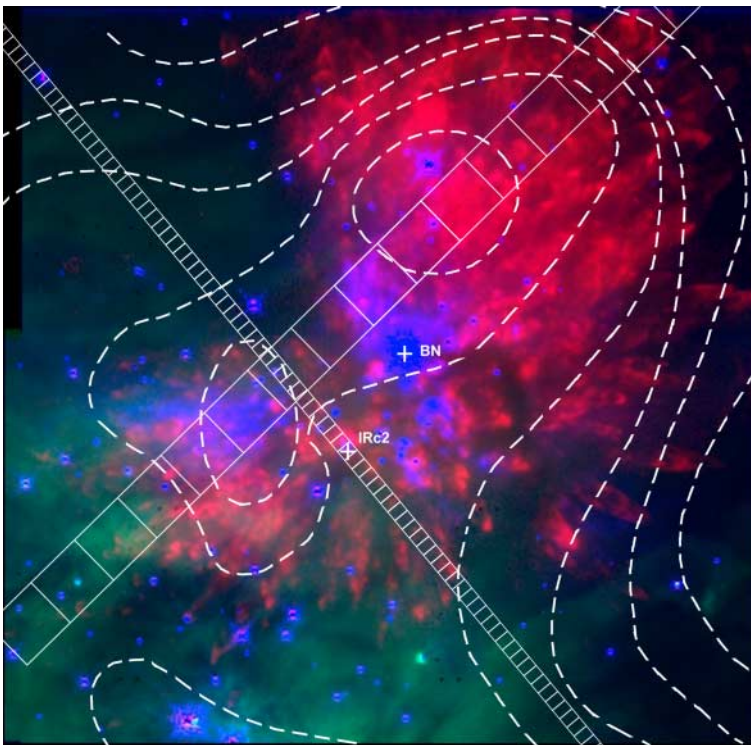
An Airborne Infra-Red Echelle Spectrometer for SOFIA



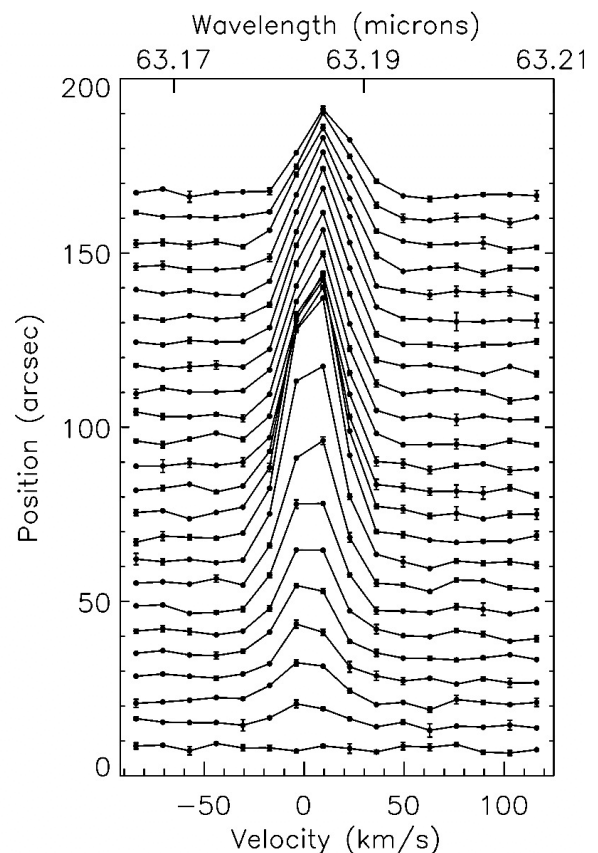
Ames Research Center



SOFIA, the Stratospheric Observatory for Infrared Astronomy, will enable astronomical observations with unprecedented angular resolution at infrared wavelengths obscured from the ground. To help open this new chapter in the exploration of the infrared universe, we are building AIRES, an Airborne Infra-Red Echelle Spectrometer. AIRES will be commissioned when the flight program begins in 2002, and will be operated as a general purpose facility instrument by USRA, NASA's prime contractor for SOFIA. The two figures below illustrate some of the observational capabilities of AIRES.



A NICMOS image of Orion: molecular hydrogen ($2.1 \mu\text{m}$) emission is shown in red, P_{α} ($1.9 \mu\text{m}$) in green, and $2 \mu\text{m}$ continuum in blue. Superimposed are neutral oxygen $[\text{O I}]$ $63 \mu\text{m}$ contours measured from the KAO. The H_2 is believed to arise from a molecular shock, the $[\text{O I}]$ from a wind shock. The AIRES slit at $63 \mu\text{m}$ ($7''$ across), will permit comparison of the geometric relationship between these two shocks. Mapping across the low-velocity outflows in the $[\text{S I}]$ $25 \mu\text{m}$ line ($3''$ slit) may identify associated high-velocity wind shocks.



Synthetic spectra of the $63 \mu\text{m}$ line as could be measured with AIRES. Depending on detector type, AIRES will measure 12, 24, or 128 spectra simultaneously from different locations (pixels) along the slit. The K-mirror (image rotator) will orient the slit at any position angle on the sky.

Science

AIRES will be ideal for spectral imaging of gas-phase phenomena in the interstellar medium (ISM). Far-infrared line observations probe the pressure, density, luminosity, excitation, mass distribution, chemical composition, heating and cooling rates, and kinematics in the various components of the ISM. The lines offer invaluable and often unique diagnostics of conditions in such diverse places as star forming regions, circumstellar shells, supernova remnants, the Galactic Center, starburst galaxies, and the nuclei of active galaxies. AIRES will provide astronomers with new insights into these and other environments in the ISM. It will also be useful for studies of solar system phenomena, such as planetary atmospheres and comets, and a variety of other problems.

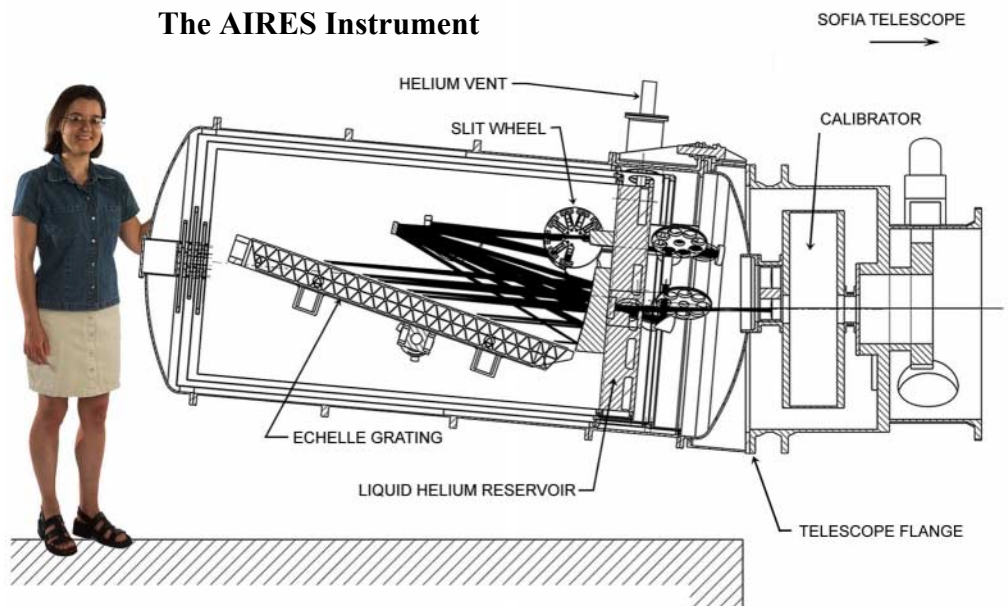
AIRES Attributes

AIRES is a long slit spectrograph with a slit viewing infrared camera. The expected system characteristics are given in the following table.

Spatial Resolution	1.2 $\lambda/D \sim (\lambda/10 \mu\text{m})''$ pixels; <i>e.g.</i> , 10'' at $\lambda = 100 \mu\text{m}$		
Slit Orientation on Sky	Selectable with cryogenic K-mirror		
Wavelength/Mode Changes	$\lesssim 1$ minute		
Spectroscopy			
Wavelength Coverage	$\lambda = 17 - 210 \mu\text{m}$		
Slit Size	$\sim 2.5'$ long with width selectable between 2'' and 35''		
Detector Arrays	17 – 40 μm :	128 x 128, $\sim 1.3''$ pixels	(Si:Sb BIB)
(spatial x spectral)	40 – 120 μm :	24 x 16, $\sim 7''$ pixels	(Ge:Sb photoconductor)
	120 – 210 μm :	12 x 8, $\sim 14''$ pixels	(Ge:Ga stressed photoconductor)
Spectral Resolution:	$R = \lambda/\Delta\lambda \sim 10^6 \mu\text{m}/\lambda$; <i>e.g.</i> , 10^4 at $\lambda = 100 \mu\text{m}$		
Free Spectral Range:	$\Delta\nu \sim 200 - 350 \text{ km/s}$		
Line Sensitivity:	$\lesssim 5 \times 10^{-21} \text{ W/cm}^2$ (4 σ , 1 h)		
Imaging/Slit Viewing			
Wavelength Bands	18, 25 μm		
Spectral Resolution	$R = \lambda/\Delta\lambda \sim 5$		
Field of View	$\sim 2.5'$ diameter (2'' slit); $\sim 1' \times 2.5'$ (wider slits)		
Detector Array	128 x 128, $\sim 1.3''$ pixels (Si:As BIB)		
Continuum Sensitivity:	$\sim 15 \text{ mJy}$ (4 σ , 1 h)		

The AIRES Instrument

A cross section of AIRES is shown mounted on the SOFIA telescope. The large echelle grating disperses light to achieve high spectral resolution. The entire optical system is cooled to 4 degrees Kelvin with liquid helium. Dr. Dotson of the AIRES team is shown with the instrument.



The AIRES Team

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For more information, visit: http://www.sofia.usra.edu/observatory/instruments/first_light/tables.html